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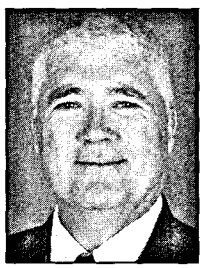

Greg Parnell, FS

Introduction

Yearly, the Dr Wilbur B. Payne Memorial Award for Excellence in Analysis is awarded to military operations researchers. The presentation of a Special Payne Award is an infrequent event given for exceptional analysis, often covering a span of several years. A Special Payne Award was awarded in 2005 and was presented by the Deputy Under Secretary of the Army (Operations Research), ***Walter Hollis*** *[FS]. It reads:*

> *For exceptionally meritorious achievement as a member of the Center for Army Analysis (CAA) analytic support team to Army Base Realignment and Closure (BRAC) for the CAA 2005 BRAC Analysis Support for the Army Basing Study (TABS), Assistant Chief of Staff for Installations (ACSIM). The team used unique and innovative applications of state-of-the-art operations research modeling, analysis techniques and skills to provide rigorous, timely, and analytically supportable critical Army BRAC recommendations to the Army senior leadership. The team's commitment to excellence reflects great credit on you, the CAA analytic support team to Army BRAC, and the United States Army. Signed by* ***Francis J. Harvey,*** *Secretary of the Army.*

I requested the authors write this article, outlining their contributions which led to their receiving this prestigious award.

E.B. Vandiver III, FS
Director, Center for Army Analysis

Last November, the 2005 round of Base Realignment and Closure (BRAC) recommendations became law. These recommendations will help reshape the Army by closing 400 installations (13 active components, 176 Army Reserve Centers, and 211 National Guard Armories) and realigning 56 active components. The actions will impact 43 states, cost about $13 billion, and generate an expected 20-year net savings of $7.6 billion. After BRAC completion, the Army expects recurring savings of $1.5 billion annually, 1.7 times greater than the recurring Army savings of the prior four BRAC rounds combined.

How were these Army BRAC actions decided and what was the role of operations research in the decision making process? We outline the role of analysis in the BRAC 2005 process, emphasizing the most influential drivers: long-term planning; data collection and validation; development of models; selection and training of key analysts; analysis flexibility; bold execution; and, analysis transparency. We also share our views on some of the deliberations and the decision making process.

BRAC 2005 Background

The Department of Defense conducted four BRAC rounds from 1988 to 1995, in which the Army closed 112 installations and realigned 26 others as well as numerous laboratory sites. These prior rounds had costs of $5.6 billion and produced $9.8 billion in savings, with annual recurring savings of $0.9 billion [Department of the Army 2005].[1] In spite of these improvements, the Department and the Army believed there remained surplus installation capacity and opportunities for additional savings.

In November 2002, the Secretary of Defense stated that, while BRAC 2005 must continue to pursue the reduction of surplus infrastructure, it "can make an even more profound contribution to transforming the Department by rationalizing our infrastructure with defense strategy. BRAC 2005 should be the means by which we reconfigure our current infrastructure into one in which operational capacity maximizes both warfighting capability and efficiency" [Department of the Army 2005].[1]

The Army embraced this guidance and viewed BRAC 2005 as a critical component of its transformation. BRAC 2005 enables the Army to reshape the infrastructure supporting current and future forces, making them even more relevant and combat ready for combatant commanders [Department of the Army 2005].[1]

Upfront Analyst Reflections

BRAC 2005 was a challenging and rewarding experience. We expected a highly charged and stressful environment; we were not disappointed. As in any important and high impact analysis, politics was a primary concern. Before and during the BRAC analysis, and still today, we are continuously asked how politics influenced the analysis and final BRAC decisions. In regards to the latter, politics may have played a part in some of the final BRAC recommendations, though they did not affect the way we conducted our analysis. We were able to mitigate political interference at our level primarily through two techniques: objectivity and transparency. We did not use any constraints to force any decision for political reasons. If the lead-

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ership made a decision that contradicted one of our analysis recommendations, we responded with sensitivity analysis that highlighted unintended consequences with that particular decision. By not building in arbitrary political constraints, we helped the senior Army leadership make informed decisions. Additionally, we relied on a transparent modeling and analysis process to help others accept the Army recommendations. Transparency was critical to justifying recommendations to the auditing agencies and the BRAC 2005 Commission. Final solutions were centered on maneuver land and growing requirements for that land, which made sense to the Army leadership and to the analysts. Future requirements were uncertain which added complexity to the both the analysis and the decisions regarding closures. We completed sensitivity analysis and used subject matter experts to develop quality estimates whenever possible.

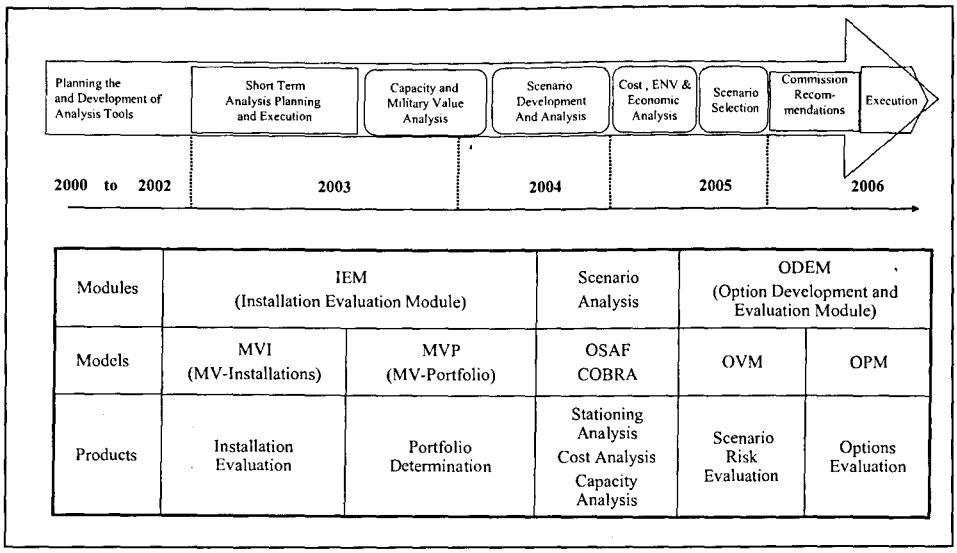
BRAC 2005 Organization

The Secretary of Defense received candidate BRAC recommendations from the Infrastructure Steering Group and each service. The organization and analysis for each service differed substantially [Defense Base Closure and Realignment Commission 2005].[2] The Army Senior Review Group (SRG) oversaw all aspects of Army analysis. Dr **Craig College**, Deputy Assistant Secretary of the Army for Infrastructure Analysis, reported directly to the SRG. Dr College also led The Army Basing Study, (TABS) the group responsible for generating the Army's recommendations for closure and realignment and coordinating all Army BRAC 2005 analysis. TABS asked the Center for Army Analysis (CAA) to dedicate an analysis cell to provide direct support for the duration of BRAC 2005. In addition, the United States Military Academy, the Naval Postgraduate School, and others provided expert advice and analysis.

Long-Term Planning

The Army began planning for BRAC 2005 before the round was legislated. In 2000, in preparation for the 2001 Quadrennial Defense Review, Mr **E. B. Vandiver III**, FS, Director of CAA, authorized (then LTC) **Bill Tarantino** to form a stationing analysis cell within CAA. This cell collected and validated Army facility, range, and training land data; designed installation and stationing analysis tools; and trained personnel to conduct stationing analysis for the Army's Deputy Chief of Staff for Operations and Plans (G-3), the Assistant Secretary for Installations and Environment, and the Assistant Chief of Staff for Installation Management. With assistance from Dr **Rob Dell**, CAA began thinking about the "next" BRAC, and how to improve their stationing analysis capabilities. This long-term planning and preparation proved valuable.

In 2003, MAJ **Lee Ewing** took control of the Stationing Analysis Cell at CAA, while COL Tarantino moved to TABS to become Chief of the Modeling and Support Team. Planning shifted to the near term. Even though TABS and CAA had not received official BRAC guidance, the Army BRAC analysis team (the TABS Modeling and Support Team and the CAA Stationing Analysis Cell) developed a timeline and analysis plan, estimating the time required to refine existing models, collect and manage data, and develop decision analysis models and linear integer programming models to support Military Value Analysis, Scenario Selection, and Economic Analysis (Figure 1).



Modules	IEM (Installation Evaluation Module)		Scenario Analysis	ODEM (Option Development and Evaluation Module)	
Models	MVI (MV-Installations)	MVP (MV-Portfolio)	OSAF COBRA	OVM	OPM
Products	Installation Evaluation	Portfolio Determination	Stationing Analysis Cost Analysis Capacity Analysis	Scenario Risk Evaluation	Options Evaluation

Figure 1. Analysis overview and timeline, primary models, and analysis products. The timeline includes different BRAC 2005 steps that begin prior to the 2001 QDR and continued with the development and employment of analyses tools through the BRAC scenario development and analysis phase in 2004. Primary phases included data collection and military value analysis, scenario development and selection, cost, environmental, and economic analyses. The military value portfolio analysis was conducted using the IEM. The IEM consisted of two models, the Military Value of Installations model (multi-objective decision analysis) and the Military Value Portfolio model (integer programming model). Many other models were used to conduct scenario, cost, and stationing analysis, e.g., OSAF (Optimal Stationing of Army Forces) and COBRA (Cost of Base Realignment Actions) [Department of the Army 2005].[1] Once candidate recommendations were developed, the Option Development and Evaluation Module or ODEM (Option Value Model (OVM) and Option Portfolio Model (OPM)) helped the Senior Review Group evaluate candidate recommendations for inclusion in the Army's final recommendations.

The BRAC legislation passed by Congress specified that military value would drive decisions for the BRAC Commission and the military. Our challenge was to determine how to solve a complex multiple objective problem and also consider the *qualitative* aspects in our analysis, which would be beneficial to decision makers. In retrospect, this situation is not unusual. All major strategy or policy analysis involves competing objectives, many are naturally qualitative. Very early in our planning we decided to use multiple objective decision analysis in conjunction with mathematical optimization models. TABS asked Dr **Greg Parnell**, FS to assist with the decision analysis needed for the military value devel-

opment. Figure 1 illustrates the primary models and analysis products used to inform the SRG. The IEM produced the portfolio of installations based on military value as required by Congress [Department of the Army 2005].[1]

Once the SRG approved the installation portfolio, TABS generated the candidate recommendations and conducted scenario analysis on these candidate recommendations. TABS evaluated all viable scenario costs with the COBRA model [Department of the Army 2005].[1] CAA and TABS evaluated brigade stationing options, including the restationing of units from Europe and Korea using the OSAF model [e.g., Dell and Tarantino 2003].[3]

We viewed the Military Value Analysis as a cornerstone of the BRAC analysis, requiring senior leader involvement, a mathematically sound model, and discernible results. For example, the analysis did not compare installations on a "1 to n" ranking of any prioritization list, but, instead, focused the decision maker on installations (or other entities) within each quartile of a list. Another key point was to seek an answer to the question "what is important?" Throughout the analysis, we found constraining factors, for example, only 11 Army installations have more than 10,000 buildable acres and linear constraints (Army level) that give the impression of excess, but installation level analysis indicates a shortage of buildable acres for many of the these large installations. All of these issues are addressed within the Military Value Analysis and other analyses mentioned below that focus on the most important installation characteristics.

Preparation of People and Tools

Development of the CAA stationing cell was key. In addition to MAJ Ewing, the CAA cell consisted of Mr **Jeff Bassichis**, Mr **John Bott**, and Mr **Richard Pedersen** (all winners of a Special Payne Award in 2005). Other contributors included **Linda Coblentz**, Dr **Charles Leake**, and Mr **Joe McGill**, who completed individual studies. The stationing cell is located in CAA's Resource Analysis Division, under the leadership of Mr **David Russo**. Each cell member had a graduate degree in Operations Research or a related discipline and each was an expert in Army facilities database management, facilities engineering, optimization, and/or decision analysis.

In 2001, CAA updated the COBRA model to a Microsoft Windows [Microsoft, 2005][4] environment with increased capability. This enabled the BRAC COBRA Joint Project Action Team to prepare COBRA for all the services and the Joint Cross Service Groups, so it could be used for all cost analysis done in BRAC. CAA conducted numerous stationing studies from 2001 to 2003, using analysis tools such as OSAF [e.g., Conners et al, 2001, Tarantino, 2002].[5,6] The early deployment and use of OSAF and COBRA prepared analysts for BRAC 2005 analysis.

A key to execution of an analysis plan lies in the **flexibility** of the plan. We attribute our success to several conscious decisions by the authors and the Army leadership.

1. ***Focus on cost savings and transformation***. The Government Accountability Office and the BRAC Commission accepted the Army's BRAC 1995 military value analysis. Initially, there was institutional support to keep the status quo analysis of BRAC 1995. Because of the mandate by the Secretary of Defense to include Defense and Army transformation in the military value analysis, we had to deviate from "business as usual." Given the ***ability to change***, Dr College and the Army SRG supported a new BRAC 2005 military value approach.

   We cannot overemphasize the importance of transformation to our analysis. All of our decision models, and much of the sensitivity analysis we performed using optimization, emphasized the analysis of *transformation options*. For example, OSAF was used extensively to examine the effects of combining the infantry and armor schools on the stationing of combat brigades returning from Germany and Korea.
2. ***Removal of the installation function constraint***. We removed the BRAC 1995 constraint that compared installations only within functions. We compared all installations using one military value model, e.g., we evaluated Fort Hood (a maneuver installation) and Aberdeen Proving Ground (a test and evaluation installation) using the same military value model. Removing this constraint helped the Army develop more flexible realignment and closure options.
3. ***We were bold in our analysis plan and execution***. We delivered more analysis than required to merely inform the BRAC decisions. Our analysis looked at the transformation options the Army leadership wanted to consider in the BRAC round, not only cost-saving alternatives. We considered risk to both the force and future Army budgets in all of our stationing analysis.

Changing the past analysis approach, including the way the Army viewed installations, was a great success. More importantly, we made a difference with the quality of the BRAC solution.

Analysis Transparency

Transparent analysis enables flexibility and bold execution. The Army Audit Agency, the Government Accountability Office, and other participants from the BRAC Commission commented informally that the Army's analysis surpassed expectations with its quality and transparency. Three areas that contributed to the transparency of the Army's BRAC analysis are:

1. Every step of the military value analysis was made available to the Army Audit Agency. The auditors questioned data, evaluated the models, and interviewed the analysts before results were released to the BRAC Commission.
2. Even before we collected the first data, we began documentation. We continued documentation throughout more than two years of BRAC analysis and made it available. This helped the Army Audit Agency and Government Accountability Office to track the Army's modeling and analysis efforts, thus gaining the confidence of senior leadership and BRAC Commission members.
3. We applied analysis in areas to reduce the appearance of *ad hoc* or subjective decisions. For example, we developed the Option Development and Evaluation Module (ODEM) [Department of the Army 2005][1] to provide additional analytical rigor by reducing the subjective nature of selecting candidate recommendations.

Documentation is painful but necessary (just like data management). Our recommendations: start early, write all the time, and finish with a complete report of your effort; it pays off. Thorough documentation of our effort allows others to see what we

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with current and future Sponsors. There's a lot to be done in one year as President, and if elected, I pledge to provide the general membership with a Report Card at the Plenary Session of the 76th MORSS in June 2008, reminding you of what I said I'd do in this article and how well the Board thought I did.

Biography

*Mr **Jack Keane** is currently serving as the Supervisor of the Aviation Systems Engineering Group at the Johns Hopkins University Applied Physics Laboratory. He received a B.S. in Electrical Engineering from The Virginia Military Institute in 1980 and an M.S. in Operations Research from The Naval Postgraduate School in 1993. He has conducted affordability analyses for the JSF Program Office, served as a member of DoD's Simulation Based Acquisition Joint Task Force and as lead analyst on the POET Validation Team for Wargame 2000, participated in numerous studies involving force composition and command and control, and led the APL Multi-mission Maritime Aircraft Team from 2001 until 2004. Mr. Keane is a member of the adjunct faculty of the JHU Whiting School of Engineering. He has served as a working group chair, composite group chair, working group and composite group coordinator, symposium chair, and membership committee chair. He has been a member of the MORS Board of Directors since 2000. Jack began his service to the Executive Council in 2004 as the Secretary and is currently serving as the Vice President for Meeting Operations.* ✪

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did and improve on our analysis in the future.

Conclusions

The Army BRAC 2005 study was planned for over two years and then successfully executed in a 2½ year study. Prior planning ensured the formation of a well-trained analysis team who had been working stationing problems years before BRAC began. Most important, ***the BRAC commission approved 95% of all the Army's closure and realignment recommendations***. These decisions will ultimately help reshape the Army.

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Resource

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Biographies

*MAJ **Lee Ewing** is an Assistant Professor and military faculty member of Operations Research at the Naval Postgraduate School. He served as an Army Operations Research Analyst at the CAA before he assumed his NPS faculty position in June 2005. His operational experience includes a tour with the 82nd Airborne Division during Operation Desert Shield/Desert Storm and command of two Special Forces operational detachments. He recently received a Special Army Payne Award for excellence in operations research for his contributions to the 2005 Army BRAC analysis.*

*COL **Bill Tarantino** is the Associate Dean, Graduate School of Operational and Information Sciences, Naval Postgraduate School. As an Army Operations Research Analysts for the last 16 years, Bill has applied optimization, decision analysis, simulation, and other operations research methods to stationing, deployment, capital budgeting, and other military problems. Bill served as the Modeling Team Chief for the Army's Total Army Basing Study, the body responsible for the 2005 Army Base Realignment and Closure. Bill won the 2000 INFORMS Edelman Award and has also received two Army Team Payne Awards for excellence in operations research.*

*Dr **Robert F. Dell** is an Associate Professor of Operations Research at the Naval Postgraduate School. Since 1990, he has taught and applied optimization to a variety of military problems and received continuous support for Army Base Realignment and Closure. He has received additional research support from every uniformed service for topics ranging from naval capital planning to Coast Guard cutter scheduling. He has also applied optimization in the private sector in areas ranging from production scheduling to supply chain design. His research appears in many open literature publications. He recently received a Special Army Payne Award for excellence in operations research for his contributions to the 2005 Army BRAC analysis.*

*Dr **Gregory S. Parnell**, FS is Professor of Systems Engineering at the United States Military Academy at West Point. He teaches decision analysis, systems engineering, and operations research. He is also a Senior Principal for Innovative Decisions Inc., a leading decision analysis firm focusing on intelligence, defense, and commercial consulting. His research and consulting involves multiple objective decision analysis, risk analysis, resource allocation decision-making, research and development (R&D) portfolio analysis, and strategic planning. He recently received a Special Army Payne Award for excellence in operations research for his contributions to the 2005 Army BRAC analysis.* ✪